CLIMAS Arizona Recent and Past Drought Fact Sheet

Arizona was officially declared a drought disaster area in May 2002, but some climate experts say dry conditions began as early as 1996. Drought has been worsening in the Southwest over the past four years. By the summer of 2002 most of Arizona was considered to be in "extreme" drought. This fact sheet uses instrumental and tree-ring data to compare recent dry conditions with droughts of the past.

The Instrumental Record (1896–2002)

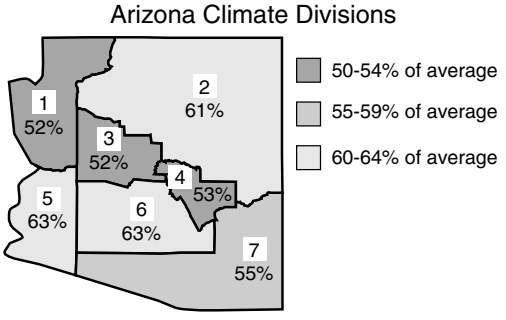
For Arizona as a whole, 2002 was one of the driest years on record based on cool-season precipitation data for 1896 to 2002. During this period other droughts stand out as comparable to recent drought conditions. Cool-season precipitation (November–April) was:

- 16.1% of average in 1904
- 27.5% of average in 2002
- 30.5% of average in 1972

Based on four-year precipitation totals, 1999-2002 was the driest spell of the instrumental record based on a statewide average. Cool-season precipitation was

- 57.0% of average for 1999–2002
- 60.2% of average for 1901–1904
- 63.8% of average for 1969–1972
- 64.4% of average for 1954–1957

It is important to point out that drought conditions in Arizona can vary considerably across space. For example, cool-season precipitation throughout Arizona between 1999-2002 was below average statewide, but some areas experienced drier conditions than others.



Note: The mechanisms that lead to any specific drought period may be different from one drought to the next, making estimation of severity and duration difficult. Also, the climate system may be in a different state today than in the past, making comparisons with past droughts troublesome. The rankings presented may vary with season, data type, and period of record used in the analysis.

Tree-Ring Records (AD 1000 to 1896)

From AD 1000 to AD 1896, 45 years had less than 50% of average cool-season (November–April) precipitation, based on statewide average of tree-ring reconstructions for the climate divisions. The driest winters in the reconstruction were

- 1670, with 20.6% of average precipitation
- 1773, with 22.1% of average precipitation
- 1150, with 25.1% of average precipitation

The driest four-year periods were

- 1668–1671, with 47.1% of average precipitation
- 1215–1218, with 49.1% of average precipitation
- 1148–1151, with 52.0% of average precipitation
- 1779–1782, with 54.0% of average precipitation

Droughts spanning more than one consecutive year, with less than 75% of the average cool-season precipitation, occurred 44 times in the record.

- 2-year droughts occurred 30 times
- 3-year droughts occurred 9 times
- 4-year droughts occurred 1 time
- 5-year droughts occurred 2 times
- 6-year or longer droughts occurred 2 times

There are three notable extended droughts in the tree-ring record:

1571–1598 (28-year duration)

- 73.6% of average cool-season precipitation
- No winters between 1571–1598 received average or greater-than-average cool-season precipitation
- Eleven years received less than 75% of average cool-season precipitation

1654–1671 (18-year duration)

- 66.1% of average cool-season precipitation
- Only two years between 1654–1670 received average or greater-than-average precipitation
- Twelve years received less than 75% of average cool-season precipitation and four years were less than 50% of average

1773–1790 (18 year duration)

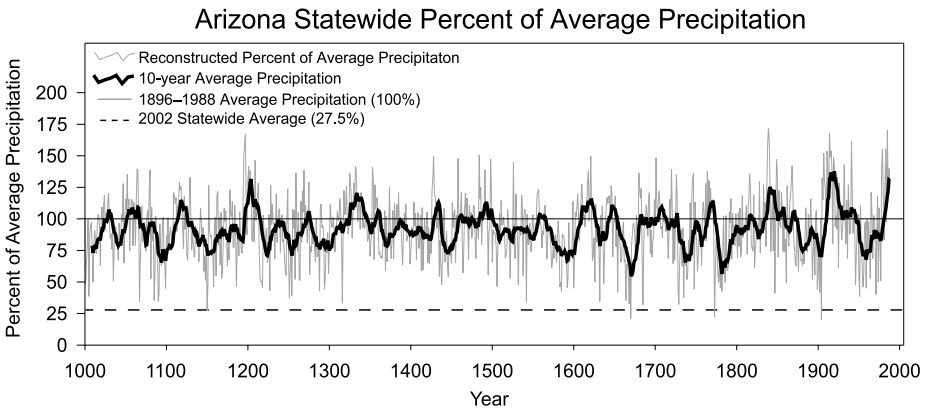
- 64% of average cool-season precipitation
- Only one year between 1773–1790 received average or greater-than-average precipitation
- Thirteen years received less than 75% of average cool-season precipitation and four years were less than 50% of average

Using Tree Rings to Reconstruct Precipitation

The formation of annual rings in trees can be related to climate using statistics and knowledge of the physical mechanisms responsible for ring growth. In the Southwest, the ring width of many tree species depends primarily on the amount of precipitation that falls, especially during the cool season (November–April).

Estimates of cool-season precipitation for climate divisions in Arizona and New Mexico for the period AD 1000–1988 were developed from hundreds of trees growing in many different areas across the West. Tree rings do best at estimating low precipitation totals, as a lack of precipitation limits tree growth. The estimates displayed here use nonlinear statistics in order to improve high precipitation estimates.

Shown in the graph is a statewide average of precipitation reconstructions for each Arizona climate division; values are expressed as the percentage of the 1896–1988 average precipitation. This graph provides a broad overview of Arizona cool-season precipitation. The 2002 statewide average, based on Arizona climate division precipitation received between Nov. 2001–April 2002, is plotted for comparison. The reconstruction indicates that a handful of years in the past thousand years were as dry or drier than 2002. Several extended dry periods stand out, particularly the late 1500s and 1600s, as well as the mid-1700s. More geographically explicit precipitation reconstructions for each Arizona climate division, which show within state differences in the strength, timing, and duration of dry and wet periods, will soon be made available on the CLIMAS web site.



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The Climate Assessment for the Southwest (CLIMAS) project was established by NOAA, in conjunction with the University of Arizona, to assess the impacts of climate variability and longer-term climate change on human and natural systems in the Southwest. Our mission is to improve the ability of the region to respond sufficiently and appropriately to climatic events and climate changes.